Earth System Research Laboratory
Global Systems Division
HIWPP

Developing the Next-Generation Weather Models

What Does ESRL's Global Systems Division Do for the Nation?

The Global Systems Division (GSD), part of NOAA's Earth System Research Laboratory (ESRL) provides the National Weather Service (NWS) and the nation with environmental observing, prediction, computer, visualization, and information systems. The High Impact Weather Project (HIWPP), funded by the Disaster Relief Appropriations Act of 2013, is addressing the severe weather needs of the nation and the world by developing the best possible one to two-week forecasts from advanced global models.

www.esrl.noaa.gov/gsd/

GSD Leads High Impact Weather Prediction Project

HIWPP: The High Impact Weather Prediction Project (HIWPP, pronounced "hi-whip") is currently working towards the following goals.

- Improving current global weather models by increasing the spatial resolution from 25-30 km to 10-13 km, and improving the model physics
- Testing next-generation global weather models in a real-time running mode at resolutions even higher than 10km
- Using a nested moving hurricane model that zooms in on tropical cyclones within a global model to enable more detailed hurricane track and intensity forecasts
- Expanding and evaluating the North American Multi-Model Ensemble, a system to combine multiple climate models from the US and Canada, to include forecasts of extreme weather events out to months.
- Using cutting-edge visualization technology to evaluate new model output
- Partnering with the broader weather community, including private companies and academic partners to assess the accuracy of these research models in real time.

Hurricane Sandy, October 28, 2012; image captured by GOES-13 satellite. Source: NASA Earth Observatory image by Robert Simmon

Flooding in Jamestown, Colorado September 15, 2013. Source: Helen H. Richardson, Denver Post

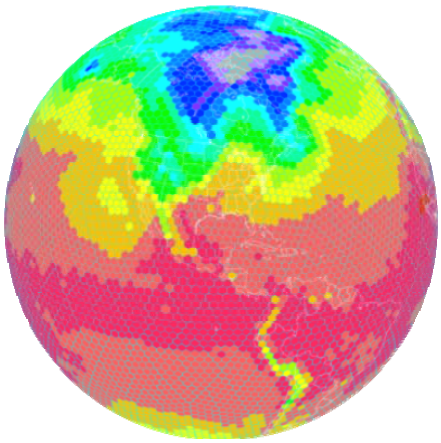
2015 HIWPP Highlights:

Testing of Current Generation Hydrostatic Models:

Scientists working on HIWPP are evaluating the current generation of models that are running at unprecedented resolutions. New techniques for assimilating observations and the earth's physical processes are being developed and evaluated.

By testing these models at the highest resolutions and with the current techniques we have available, a forecast benchmark will be established and used for evaluating the accuracy and performance of the next generation non-hydrostatic models that explicitly resolve convection.

Since January 2015, these three models, including the Flow-Following Finite-Volume Icosahedral Model (FIM) shown to the right, have been running in real-time and will continue for one year allowing scientists time to evaluate the model output and compare the different techniques used for combining the model outputs.



NOAA/ESRL's Flow-Following Finite-Volume Icosahedral Model (FIM), a current generation hydrostatic model, in testing by HIWPP showing temperatures at the lowest model level.

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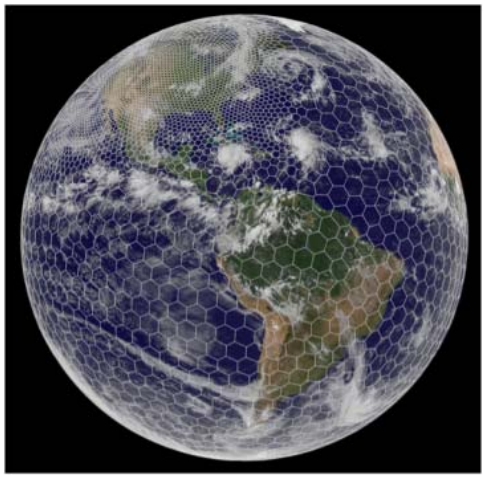
More 2015 HIWPP Highlights:

Testing of Next Generation Non-Hydrostatic Models

The next generation global weather models are non-hydrostatic, which supports model forecasts at much higher resolutions. Under GSD leadership, HIWPP scientists are evaluating five new non-hydrostatic models, including the National Center for Atmospheric Research's (NCAR) Model for Predication Across Scales (MPAS), with rigorous testing. First, each model has been run on a suite of idealized test cases and the outcome is compared covering a range of challenging weather phenomena. The models are now being set up to forecast historical weather events at very high resolutions, demonstrating this capability for the first time. The outcome from these rigorous tests will inform the development for the next-generation of operational global weather models.

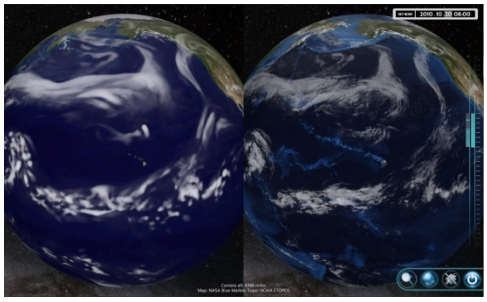


NCAR's Model for Prediction Across Scales (MPAS), a next-generation non-hydrostatic model for use in climate, regional climate and weather studies in testing by HIWPP.
Source: NCAR

NEIS Advanced Visualization Tool

In order to effectively evaluate very large sets of data produced by new weather models, HIWPP scientists are developing an advanced visualization tool to display and compare weather data and forecasts. The NOAA Earth Information System (NEIS) uses technology developed in the video gaming industry to give scientists access to tools to select, combine, view, and analyze these large data volumes in a high-resolution ultra-fast interactive display.

The first release of NEIS was made available to Beta testers in the weather community in October 2014. An updated version of release 1.0 will be available in April 2015.



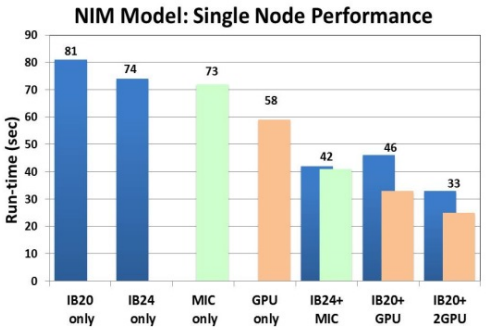
Screen from NEIS advanced visualization tool, developed in HIWPP, comparing model forecast (left) to actual satellite image (right).
Source: NOAA

HIWPP Open Data Program

As part of the HIWPP project, a process for allowing collaboration between the HIWPP modeling teams and the weather community was established through the Open Data Program. The Open Data Program was inaugurated on February 9, 2015 and allows the public, private, and academic sectors of the weather community access to forecasts produced through the HIWPP experiments. In a collaborative manner, the weather community may provide differing scientific perspectives into the development of future weather models. In addition, these participants have access to the NEIS visualization tool for viewing and analyzing the model output that is made available through the Open Data Program.

High Performance Computing (HPC) – Moving to Next Generation Systems

Running the HIWPP models at very high resolutions in real-time requires large amounts of computing resources. GSD scientists are exploring high-performance computing architectures to handle these enormous computational demands. The key to solving this dilemma lies in affordable, powerful processors called graphics-processing units or GPUs. HIWPP scientists are adapting model software to make efficient use of these cutting edge high performance architectures.



Comparison of model runtimes (y-axis) using different HPC configurations (x-axis) of next generation computers.
Source: NOAA

For more information on the Global Systems Division, visit http://esrl.noaa.gov/gsd/

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